

Journal of Endodontics, 1996, Vol. 22

JUNE

**Col. Schindler, Chairman Of Endodontics
59th MDW Dental Directorate
Lackland AFB, TX**

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JUNE (Cont.)

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- **Pulp Management in dens evaginatus**
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Influence of Particle Size of Calcium Phosphate Ceramics as a Capping Agent on the Formation of a Hard Tissue Barrier in Amputated Dental Pulp

Higashi T, Okamoto H. Influence of Particle Size of Calcium Phosphate Ceramics as a Capping Agent on the Formation of a Hard Tissue Barrier in Amputated Dental Pulp. J Endodon 1996;22:281-3.

Purpose: To elucidate the effects of particle size of hydroxyapatite and β -tricalcium phosphate on hard tissue barrier formation after experimental pulpotomy.

M&M: Pulp in 65 teeth of three dogs were amputated at the canal orifice. The pulps were cleansed with 10% NaOCl and 3% H₂O₂ and dressed with a fresh aqueous paste of hydroxyapatite-300 (particle size 300 μ m), β -tricalcium phosphate-300, hydroxyapatite-40, or β -tricalcium phosphate-40. Cavities were filled with both ZOE and Zn(PO)₄ cements. After 30 days, teeth were extracted, fixed, demineralized, sectioned and examined microscopically.

Results: Hydroxyapatite-300 and β -tricalcium phosphate-300 showed either hard tissue formation or mild inflammation. The hard tissue consisted of osteodentine structures and tubular dentine. Hydroxyapatite-40, or β -tricalcium phosphate-40 showed inflammation with slight osteodentinogenesis, and half of each group formed abscesses. No significant difference or advantage was observed between hydroxyapatite and β -tricalcium phosphate-capping agents.

C&C: These findings suggest a correlation between particle size and the degree of inflammatory reaction and the degree of osteodentinogenesis, with smaller particles initiating a much more severe inflammatory reaction.

June 1996

Robin E. Hinrichs

Toxicity of camphorated parachlorophenol in dental pulp cell culture

Soekanto A, Kasugai S, Matakai S, Ohya K, Ogura H. Toxicity of camphorated parachlorophenol in dental pulp cell culture. J Endodon 1996;22:284-6.

PURPOSE: To compare the cytotoxicity of phenol and parachlorophenol with their camphorated counterparts and with camphor alone using a 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyl tetrazolium bromide (MTT) colorimetric assay.

M & M: RPC-C2A cells (a clonal line established from the pulp of a rat incisor) were cultured in Eagle's minimum essential medium, collected and inoculated in 96-well plates. At the confluent stage, the cells were incubated for 24 hours in experimental medium containing phenol, phenol (camphorated), parachlorophenol, parachlorophenol (camphorated), and camphor. Cell survival was determined using MTT colorimetric assay measured at 540 nm.

RESULTS: All compounds had a cytotoxic effect on the cells in a concentration-dependent manner. Parachlorophenol was more toxic than phenol. When camphor was added to phenol or parachlorophenol, the toxicity of these compounds increased. The order of toxicity of these compounds (from most toxic to least toxic) was: parachlorophenol (camphorated), parachlorophenol, camphor, phenol (camphorated), and phenol.

C & C: In contrast to other studies, this study evaluated the toxicity of phenolic compounds, their camphorated counterparts, and camphor under the same experimental conditions. Originally, it was believed that the addition of camphor served as a vehicle and diluent, and that it reduced the irritating effects of pure phenol or parachlorophenol. This study demonstrated that camphor itself has cytotoxicity, and that camphorating increased the toxicity of the phenolic compounds rather than reduced it.

June 1996

Orest Harkacz, Sr.

Breakage of Ultrasonic Root-End Preparation Tips

Walmsley AD, Lumley PJ, Johnson WT, Walton RE. Breakage of Ultrasonic Root-End Preparation Tips. J Endodon 1996;22:287-9.

Purpose: To investigate whether the ultrasonic tip design is related to instrument breakage.

M&M: Ten different tip designs were driven by an ENAC piezoelectric ultrasonic unit at maximum power. Four tips with two bends - for apical preparation, three with straight designs and one bend at the tip- for isthmus preparation, two with large curvatures and narrow points - for removal of silver points, and one with a straight design and a 90 degree bend- for amalgam condensation were tested. Apexes of multirrooted teeth were instrumented with the tips laterally loaded with 100 g for 5-min time periods. Two successive five-min time periods with loads of 200 g & 300 g followed. Tips were examined with SEM before and after use.

Results: Three tips broke, two of the root-end preparation tips, and the amalgam condenser tip. All included an angle greater than 45 degrees. Breakage was between 10 s & 2.5 min at 100 g loading. Two tips bent, one isthmus preparation tip, and one for silver point removal. Bending occurred at 200 or 300 g after at least 7.5 min use. Fractures occurred primarily at the node of the vibrating tip - the point of maximum strain. They appeared to all be brittle separations.

C&C: Although only ten tips were tested, there was a correlation between tendency to fracture and increased angle of bending. The practitioner should be aware that these tips will break, and can do so very quickly, at very light loads. If customizing tips during surgery, smoother curves & lesser degrees of angulation would seem to be prudent.

June 1996

Robin E. Hinrichs

Regional variation in root dentinal tubule infection by *Streptococcus gordonii*

Love RM. Regional variation in root dentinal tubule infection by Streptococcus gordonii. J Endodon 1996;22:290-3.

PURPOSE: To investigate regional differences in tubule invasion by a single bacterial species.

M & M: Thirteen noncarious unrestored human teeth with single root canals were utilized for the study (10 for experiment and 3 for control). The crowns were removed to produce roots of equal lengths. The canals were instrumented with a step-back circumferential filing technique using 5.25% sodium hypochlorite and 17% EDTA irrigation. The roots were sectioned longitudinally through the canals and then chemically and ultrasonically treated to remove the smear layers. The specimens were incubated pulpal side facing upwards in a suspension of *Streptococcus gordonii* for 21 days, then fixed and prepared for histological analysis. Sections from the cervical, midroot, and apical areas were examined.

RESULTS: The cervical and midroot sections of all the specimens exhibited a similar pattern of tubule invasion characterized by a heavy superficial layer of penetration involving most of the tubules. The depth of penetration was variable from one tubule to another, with the maximum depth being 200 μm . The apical sections were characterized by a mild invasion localized to portions of the root canal with large areas showing no penetration. The depth of penetration did not exceed 60 μm . In no case did bacteria invade the dentin from the cementum surface. Bacteria were not present in the control specimen.

C & C: According to the author, Carrigan et al. demonstrated that the mean number of tubules at any given age in coronal, cervical, and midroot dentin were similar. However, there were significantly less dentinal tubules per area in apical dentin, suggesting that the formation of peritubular dentin occurs more rapidly in the apical region. This could then result in varying bacterial penetration between areas of the root, as observed in this study. The author also stated that the observed pattern of invasion would favor a root canal preparation technique that results in minimal apical preparation (because of the mild and limited depth of infection there), but flares coronally, debriding the heavily infected midroot and cervical dentin.

June 1996

Orest Harkacz, Sr.

Accuracy of Endodontic Microleakage Results: Autoradiographic vs. Volumetric Measurements

Ximenez-Fyvie LA, Ximenez-Garcia C, Carter-Bartlett PM, Collado-Webber FJ. Accuracy of Endodontic Microleakage Results: Autoradiographic vs. Volumetric Measurements. J Endodon 1996;22:294-7.

Purpose: To determine the correlation between linear and volumetric measurements by radioisotope penetration.

M&M: Three groups of 24 each were obturated with: 1. nothing (control), 2. gutta percha only, and 3. gutta percha and sealer. Samples were immersed vertically for 14 days in a radioisotope media. One mm thick sections were cut. Linear penetration was recorded from autoradiographs by five independent observers. Volumetric results were based on counts per minute in a liquid scintillation spectrometer. Pearsons correlation coefficients test was used.

Results: No acceptable correlation values were found in any of the three groups. The groups did behave as expected, with the highest leakage from the empty canals, & the lowest in the GP and sealer group. There was high inconsistency between the measurements recorded by the different evaluators.

C&C: This study just highlights the need for a reliable, quantitative method to measure leakage. The numerous studies out there are not standardized, and no consensus can be drawn from them. At this point, only trends in leakage can be noted, as the methods for gathering data, and the subjectivity involved make more in-depth comparisons impossible.

June 1996

Robin E. Hinrichs

Periapical changes after orthodontic movement of root-filled ferret canines

Mah R, Holland GR, Pehowich E. Periapical changes after orthodontic movement of root-filled ferret canines. J Endodon 1996;22:298-303.

PURPOSE: 1) To determine whether nonvital teeth move as readily as vital teeth when subjected to comparable forces and, 2) to determine whether orthodontically moved, root-filled teeth showed more apical root resorption than vital teeth.

M & M: Twelve ferrets were used in the study (six received active orthodontic appliances while the other six had inactive appliances placed). Root canal therapy was performed on one randomly chosen mandibular cuspid in each ferret and obturated using gutta-percha with Sealapex sealer. Orthodontic appliances were placed bilaterally on the mandibular teeth, and depending on whether the subject was to have inactive or active movement, the springs were either left at their initial resting length or activated at a force of 150 to 175 g. Twelve weeks after appliance placement, tooth movement was assessed from pre- and posttreatment mandibular casts and by fluorescence microscopy from labeled bone deposition using procion red dye. Twenty four teeth were assessed in 4 groups: vital teeth with inactive appliances, vital teeth with active appliances, endodontically treated teeth with inactive appliances, and endodontically treated teeth with active appliances.

RESULTS: There was no significant difference in tooth movement between vital and nonvital teeth subjected to the same force, whether the tooth movement was measured by the comparison of pre- and posttreatment casts or by the amount of bone deposition. Root-filled teeth showed greater loss of cementum after tooth movement than vital teeth, but without significant differences in radiographic root length. No lesions were found in any of the vital teeth, whereas most of the nonvital teeth exhibited some degree of periapical inflammatory response.

C & C: The greater loss of cementum noted with nonvital tooth movement compared to vital tooth movement was felt to be related to the presence of periapical inflammation from the endodontic treatment, and not by the orthodontic tooth movement.

June 1996

Orest Harkacz, Sr.

Root Surface Temperatures During Post Space preparation

Weller RN, Kimbrough F, Anderson RW. Root Surface Temperatures During Post Space preparation. J Endodon 1996;22:304-7.

Purpose: To measure the temperature increase on the root surface of a tooth when a post space was created with the GPX bur. Rotation speeds from 6,500 to 15,000 rpm were evaluated.

M&M: A split-tooth model was used. Five thermocouples were placed every 3 mm, starting 1 mm coronal from the root end. The canal was filled with Obtura, and allowed to set 5 min before each procedure. Twenty post space preparations for each speed were evaluated. Speeds were 6,500, 8,000, 9,500, 11,000, and 15,000 rpm. The post space was prepared to a depth of 10 mm, with a marking on the GPX shaft to maintain a constant depth. The same bur was used for all procedures. Temperatures were recorded starting 5 s before the GPX was introduced, and at 1 s intervals for 3 m.

Results: The avg. base line temperature was 24.25⁰ C. The highest mean increase was recorded at the most coronal level, with a general decrease moving toward the apex. The lowest mean temperature was produced at 6,500 rpm, and the highest at 8,000. At the higher speeds, the temperatures recorded were less than the 8,000 rpm levels. The mean increase in temperature ranged from 0.66⁰ to 4.81⁰ C.

C&C: The authors note that at the higher speeds, the depth of increase in temperature was past the depth of the preparation. Also, more GP was removed at the higher speeds, resulting in post preparation depths greater than 10 mm. Both of these are probably related to the GP becoming thermoplasticized during post space preparation. The GP removal became more uncontrollable, and this clinically is important to know. Slower speeds should give more control over GP removal.

June 1996

Robin E. Hinrichs

A scanning electron microscopic evaluation of in vitro dentinal tubules penetration by selected anaerobic bacteria

Siqueira, Jr. JF, De Uzeda M, Fonseca MEF. A scanning electron microscopic evaluation of in vitro dentinal tubules penetration by selected anaerobic bacteria. J Endodon 1996;22:308-10.

PURPOSE: To investigate in vitro dentinal tubule penetration by selected anaerobic bacteria commonly isolated from root canal infections and associated with endodontic pathosis using scanning electron microscopy.

M & M: Dentin cylinders were prepared from mature bovine incisors which had the root cementum removed and the root canals widened to a standard diameter of ~2.0 mm. The specimens were disinfected, immersed in citric acid for smear layer removal, sterilized in an autoclave, and inoculated with bacteria (*P. endodontalis*, *F. nucleatum*, *A. israelii*, *P. gingivalis*, *P. acnes* and *E. faecalis*). *E. faecalis* is a facultative anaerobe, while the rest are obligate anaerobes. After incubation for 21 days, the specimens were prepared for SEM examination.

RESULTS: The SEM analysis revealed that all bacteria used in this experiment were able to penetrate into root dentinal tubules to different depths. No depth penetration was able to be measured due to tubule orientation and defects created in the specimen preparation. No bacterial invasion was observed in the peripheral exposed dentin.

C & C: An interesting point brought up in the discussion was that the bacteria penetrated into the tubules by way of cell division (a passive process), implying that motility does not have to be a factor for dentinal tubule penetration. They noted different patterns of invasiveness related to differences in bacterial growth rate.

June 1996

Orest Harkacz, Sr.

Kinetics of Macrophages and Lymphoid Cells During the Development of Experimentally Induced Periapical lesions in Rat Molars: A Quantitative Immunohistochemical Study

Kawashima N, Okiji T, Kosaka T, Suda H. Kinetics of Macrophages and Lymphoid Cells During the Development of Experimentally Induced Periapical lesions in Rat Molars: A Quantitative Immunohistochemical Study. J Endodon 1996;22:311-6.

Purpose: To immunohistochemically investigate the temporal changes in the number and localization of macrophages, T-lymphocyte subsets and plasma cells in a rat experimental model to further elucidate the characteristics of defensive reactions participating in the pathogenesis of the periapical lesion.

M&M: Unsealed pulp exposures were made in rat molars. After 3,7,14,28, and 56 days, the rats were killed, and the teeth and surrounding jaws were dissected out. Cells were quantitatively identified using monoclonal antibodies. Appropriate controls were used.

Results: Exudative macrophages of many morphological types were the most dominating immunocompetent cells during all experimental periods. They exhibited nearly complete distribution throughout the experimental lesions, seeming to initiate from near blood vessels and migrating outward. Macrophages dominated the center of the lesions, and dendritic cell-like cells were found predominately in the periphery of the lesions. Lymphoid cells showed an increase 14 days post injury, before the onset of active lesion expansion. CD8⁺ lymphocytes and plasma cells dominated when the lesion size was stabilized.

C&C: Macrophages seemed to act as effector cells or as antigen-presenting cells that stimulated CD4⁺ lymphocytes to induce an immune response. T-helper cells seemed to dampen the response, keeping it from being excessive, though chronic. Clinically, patients with immune deficiencies could have increased response and resulting lesion size.

June 1996

Robin E. Hinrichs

Anesthetic efficacy of the periodontal ligament injection after an inferior alveolar nerve block

Childers M, Reader A, Nist R, Beck M, Meyers WJ. Anesthetic efficacy of the periodontal ligament injection after an inferior alveolar nerve block. J Endodon 1996;22:317-20.

PURPOSE: To determine the anesthetic efficacy of an inferior alveolar nerve (IAN) block with the addition of a PDL injection in mandibular first molars.

M & M: Forty adult subjects (15 males and 25 females) randomly received a combination IAN block and PDL injections of the first molar, and a combination IAN block and mock PDL injections (needle penetration only) of the first molar at two successive appointments spaced at least 1 week apart using 2% lidocaine with 1:100000 epinephrine. The first molar and adjacent teeth, and contralateral canine (positive and negative controls) were blindly tested with an Analytic Technology pulp tester. Profound anesthesia was defined as no response at an 80 reading. Anesthesia was considered successful when an 80 reading was attained within 15 minutes and sustained for the remainder of the 60-min test period. Failure was considered if the subject never achieved 2 consecutive 80 readings during the 60 minutes.

RESULTS: One hundred percent of the subjects had subjective lip numbness. For the first molar, success was 63% with the IAN and 78% with the IAN + PDL ; failure was 15% with the IAN and 5% with the IAN + PDL. Comparing IAN + PDL injections to IAN blocks alone in the first molar, significant differences were shown through the first 23 minutes of pulp testing. After 23 minutes, there was no increase in anesthetic success by adding the PDL to the IAN injection.

C & C: The PDL injections were given after the block injections, thereby minimizing discomfort. This study indicates that higher rates of molar anesthesia can be attained for 23 minutes using the combination IAN + PDL injections. This would be adequate for pulpectomy procedures. Restorative procedures may require longer times and benefit from supplemental PDL injections given around 20 minutes after the initial injections although the potential for increased pulpal damage due to prolonged altered pulpal blood flow may occur.

June 1996

Orest Harkacz, Sr.

The Sterilization of Endodontic Hand Files

Hurt CA, Rossman LE. The Sterilization of Endodontic Hand Files. J Endodon 1996;22:321-2.

Purpose: To investigate the effectiveness of the chairside salt sterilizer in completely sterilizing endodontic hand files including the metal shaft and plastic handle.

M&M: Six groups of 15 21 mm hand files (5 ea. of size 10, 30, & 60) were initially sterilized in a steam autoclave. After contamination with *Bacillus stearothermophilus*, they were “sterilized by one of six procedures. 1. Salt, blade only, 15 s. 2. Salt, complete file, 15 s. 3. Salt, complete file, 1 m. 4. Glutaraldehyde, 12h. 5. Steam autoclave 15 m at 121⁰ C and 15 psi. 6. Not sterilized. The files were incubated & analyzed for growth.

Results: Only the files in the steam autoclave group showed complete sterilization. Group 4 had 1/15 contaminated. Group 3 had 7/15, and the others had 15/15 contaminated files.

C&C: In this study, the steam autoclave was the only method to completely & reliably sterilize endodontic hand files. Sterilization between patients is a must, after mechanical removal of debris from the file.

June 1996

Robin E. Hinrichs

Pulp Management in dens evaginatus

Augsburger RA, Wong MT. Pulp Management in dens evaginatus. J Endodon 1996;22:323-7.

PURPOSE: To describe a 4-yr follow-up of recommended treatments for the different stages of wear and pathosis associated with dens evaginatus.

SUMMARY: A 12-yr-old Guamanian girl sought treatment for pain in the maxillary right premolar region. No restorations were noted on the premolars, but small holes were located on the lingual inclines of the buccal cusps. Similar holes were located on the occlusal surfaces of teeth 12 and 28. Intact dens evaginati were noted on the occlusal surfaces of teeth 13, 20 and 29. In total, 7 of the 8 premolars were effected by dens evaginatus. Cold testing indicated vital pulps in all the teeth except tooth 4. Teeth 4 and 5 were tender to percussion and palpation. A parulis was noted on the facial gingiva mesial to tooth 4. Radiographically, all the premolar roots were incompletely formed. Tooth 4 also had a periapical radiolucent lesion. The diagnosis of tooth 4 was pulpal necrosis secondary to fracture of the dens evaginatus. Canal debridement was completed and calcium hydroxide was placed in the tooth to induce apexification. Access openings were performed in teeth 5, 12, and 28 revealing degenerating, nonbleeding tissues in the pulp chambers. Coronal calcium hydroxide pulpotomy procedures were performed on these teeth to allow for continued root development. In order to protect the evaginations of teeth 13, 20, and 29, these teeth were restored with composite reinforcements around the base of each dens evaginatus projection. The patient was recalled at 6 months, 1 yr, 18 months, 2,3 and 4 years, at which time appropriate therapy was performed (replacement of calcium hydroxide or completion of endodontic treatment). In tooth 4, the pathology resolved and closure of the root apex occurred. Subsequent routine canal obturation was completed. Bridge formation occurred in teeth 5 and 12. These pulps remained vital, and the canals were obturated to the level of the bridges. Routine endodontic treatment was performed in tooth 28 to the apex. In all three of these teeth, root development continued normally. No pathosis was noted with any other teeth.

C&C: The objective the of treatment was to allow the roots to complete normal development. Previously, this development has been referred to as apexogenesis or maturogenesis. In this article, the authors propose the term radiculogenesis, stating it more specifically relates to the roots. Radiculogenesis by their definition would include any procedure intended to ensure complete root formation under conditions of adversity.

June 1996

Orest Harkacz, Sr.

Endoscope- An Endodontic Application

Held SA, Kao YH, Wells D. Endoscope- An Endodontic Application. J Endodon 1996;22:327-9.

Purpose: To extol the virtues of the endoscope in endodontic surgery.

Summary: A 30- and 70-degree endoscope has been found to allow visualization in previously inaccessible areas during endodontic surgery involving maxillary and mandibular molars. Using the 70-degree instrument allows the operator to view a full 360-degree radius of the palatal root apices. Visualizing roots tucked behind other roots also can be accomplished. It may also be used to magnify & visualize the pulp chamber as an aid for identification of the canal orifices. If maxillary molar roots are in the sinus, this instrument can aid the operator in the identification and treatment of these roots, via entry into the sinus. A case report of this last instance was presented. After 3 years of symptoms unresolved with conventional endodontics, surgery on the buccal roots, and antibiotics, an endodontic surgery with the endoscope was done. A Caldwell-Luc procedure was performed, and the endoscope permitted identification of the palatal root, diffuse polypoid changes and a large periapical cyst attached to the root in the antrum of the sinus. After an apicoectomy and root-end filling, the patient exhibited complete healing and resolution of symptoms at a 3y follow-up.

C&C: The endoscope would seem to have some major advantages over the surgical microscope; it can “look around corners” and is much cheaper. Two disadvantages are that it must be placed in the surgical field, and must be held by someone - either the operator or the assistant.

June 1996

Robin E. Hinrichs